

WHAT IS CLAIMED IS:

1. An article of manufacture that is comprised of a soft thermoplastic elastomer composition overmolded onto a hard substrate wherein the soft thermoplastic  
5 composition is comprised of (a) 5 to 60 parts by weight of a thermoplastic resin selected from the group consisting of polyolefin resins and polystyrene, (b) 5 to 70 parts by weight of a rubbery elastomer that is comprised of repeat units that are derived from a conjugated diene monomer selected from 1,3-butadiene and isoprene, wherein the rubbery elastomer is optionally at least partially crosslinked, wherein the repeat units in  
10 the rubbery polymer are distributed throughout the rubbery polymer in an essentially random manner, and wherein the rubbery polymer is a solution polymer, (c) 5 to 90 parts by weight of a highly saturated elastomer selected from the group consisting of styrene-ethylene butylene-styrene polymers, styrene-ethylene propylene-styrene polymers, hydrogenated polybutadiene, hydrogenated polyisoprene, hydrogenated styrene-isoprene  
15 random copolymers, hydrogenated styrene-butadiene random copolymers, and (d) 15 to 200 parts by weight of an oil.
2. An article of manufacture as specified in claim 1 wherein the thermoplastic resin is a syndiotactic polypropylene having a melt flow rate at 230°C and  
20 2.16 Kg load of greater than 0.5 g/10 minutes.
3. An article of manufacture as specified in claim 1 wherein the thermoplastic resin is a syndiotactic polypropylene having a melt flow rate at 230°C and 2.16 Kg load that is within the range from 20 g/10 minutes to about 110 g/10 minutes.  
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4. An article of manufacture as specified in claim 1 wherein the thermoplastic resin is a polyolefin resin that is substantially crystalline and has a melting point of at least 70°C as measured in a differential scanning calorimeter at a heating rate of 10°C per minute.  
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5. An article of manufacture as specified in claim 1 wherein the elastomer is synthesized by solution polymerization and wherein the highly saturated elastomer is crosslinked.

6. An article of manufacture as specified in claim 1 wherein the thermoplastic resin is a polyolefin resin, and wherein the polyolefin resin, the elastomer polymerized by solution polymerization, and the highly saturated elastomer are at least partially crosslinked.

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7. An article of manufacture as specified in claim 1 wherein the hard substrate is a thermoplastic resin selected from the group of polypropylene, polyethylene, polystyrene, high impact polystyrene, polycarbonate, polybutylene terephthalate, nylon 6, nylon 11, nylon 12, nylon 6-10, acrylonitrile-butadiene-styrene copolymer, styrene-acrylonitrile copolymer, and polyacetal.

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8. An article of manufacture as specified in claim 1 wherein at least 75 percent of the double bonds originally present in the highly saturated elastomer are saturated by hydrogenation.

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9. An article of manufacture as specified in claim 1 wherein the soft thermoplastic elastomer composition is further comprised of at least one processing aid.

10. An article of manufacture as specified in claim 1 wherein the soft thermoplastic elastomer composition is further comprised of oils selected from the group of paraffinic and naphthenic oils.

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11. An article of manufacture as specified in 1 wherein the soft thermoplastic elastomer composition is further comprised of a reinforcement selected from the group of talc, clay, calcium carbonate, silica, carbon black and wollastonite.

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12. An article of manufacture as specified in claim 1 wherein the hard substrate is a thermoplastic resin, and wherein the thermoplastic resin contains a reinforcement selected from the group of talc, wollastonite, glass fibers, clay, glass spheres, calcium carbonate, and silica.

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13. An article of manufacture as specified in claim 1 wherein the rubbery elastomer in the soft thermoplastic elastomer composition is dynamically crosslinked in

the melt mixing process step with the polyolefin resin, wherein the rubbery elastomer is comprised of repeat units that are derived from a conjugated diolefin monomer, and wherein said rubbery elastomer is unsaturated.

5           14.     An article of manufacture as specified in claim 1 wherein the soft thermoplastic composition is comprised of a rubbery elastomer that is a styrene-butadiene random copolymer with a bound styrene content of about 10 to 40 weight percent of the said elastomer, wherein the rubbery elastomer is comprised of repeat units that are derived from a conjugated diolefin monomer, and wherein said rubbery  
10   elastomer is unsaturated.

          15.     An article of manufacture as specified in claim 1 wherein the rubbery elastomer is a styrene-isoprene random copolymer having a bound styrene content that is within the range of about 10 to 40 weight percent, and wherein said rubbery elastomer is  
15   unsaturated.

          16.     An article of manufacture as specified in claim 1 wherein the rubbery elastomer has a Mooney ML 1+4 viscosity at 100°C which is within the range of 15 to about 120, wherein the rubbery elastomer is comprised of repeat units that are derived  
20   from a conjugated diolefin monomer, and wherein said rubbery elastomer is unsaturated.

          17.     A process for manufacturing an article of manufacture that comprises (1) melt blending (a) 5 to 60 parts by weight of a thermoplastic resin selected from the group consisting of polyolefin resins and polystyrene, (b) 5 to 70 parts of a rubbery elastomer  
25   that is comprised of repeat resin units that are derived from a conjugated diene monomer selected from 1,3-butadiene and isoprene, wherein the rubbery elastomer is optionally at least partially crosslinked, wherein the repeat units in the rubbery polymer are distributed throughout the rubbery polymer in an essentially random manner, and wherein the rubbery polymer is a solution polymer, (c) 5 to 90 parts of a highly saturated elastomer  
30   selected from the group consisting of styrene-ethylene butylene-styrene polymers, styrene-ethylene propylene-styrene polymers , hydrogenated polybutadiene, hydrogenated polyisoprene, hydrogenated styrene-isoprene random copolymers, hydrogenated styrene-butadiene random copolymers, and (d) a crosslinking agent to

produce a soft thermoplastic composition, wherein the melt blending is conducted above the melt point of the thermoplastic resin, and wherein the crosslinking of the rubbery elastomer is conducted in a continuous mixer; (2) pelletizing the soft thermoplastic elastomer composition as it is being discharged from the mixer, (3) overmolding the soft thermoplastic elastomer composition onto a hard substrate to produce the article of manufacture.

18. A process as specified in claim 17 wherein the soft thermoplastic elastomer composition is overmolded on a hard substrate in step (3) by a two-shot injection molding process, a co-injection molding process, or a multicomponent injection molding process, and an insert injection molding process.

19. An article of manufacture as specified in claim 1 wherein the article of manufacture is selected from the group consisting of shaving razors, toothbrushes, soft-grip pens, power tools, kitchen appliances, kitchen utensils, and keypads.

20. The process as specified in claim 19 wherein highly saturated elastomer is a styrene-ethylene butylene-styrene triblock copolymer having a styrene content within the range of 15 weight percent to 40 weight percent.

21. An article of manufacture as specified in claim 1 wherein the soft thermoplastic elastomer has a Young's modulus that is at least 10 MPa less than the Young's modulus of the hard substrate.

22. An article as specified in claim 1 wherein a thermoplastic resin is selected from the group consisting of polyethylene, isotactic polypropylene, syndiotactic polypropylene, polypropylene impact copolymers containing about 1-7 % by weight of ethylene, butene, hexene, or octene, polyolefin copolymers, polybutene, reactor grade modified polypropylene, oxypolyolefins, and metallocene polypropylene.

23. An article as specified in claim 22 wherein the thermoplastic resin is a polyolefin copolymer having repeat units that are derived from at least two members selected from the group consisting of ethylene, propylene, butene, hexene, and octene.

24. An article as specified in claim 1 wherein the rubbery polymer is further comprised of repeat units that are derived from a vinyl aromatic monomer selected from the group consisting of styrene and alpha-methyl styrene, and wherein said rubbery elastomer is unsaturated.

25. An article as specified in claim 1 wherein the soft thermoplastic composition is comprised of (a) 10 to 40 parts by weight of the polyolefin resin, (b) 10 to 65 parts by weight of the rubbery elastomer and (c) 10 to 65 parts by weight of the highly saturated elastomer, and (d) 20 to 70 parts by weight of the oil.

26. An article as specified in claim 1 wherein the soft thermoplastic composition is comprised of (a) 15 to 25 parts by weight of the polyolefin resin, (b) 45 to 55 parts by weight of the rubbery elastomer and (c) 25 to 35 parts by weight of the highly saturated elastomer, and (d) 20 to 70 parts by weight of the oil.

27. An article of manufacture as specified in claim 1 wherein the thermoplastic resin is a syndiotactic polypropylene copolymer.

28. A polymeric composition which is comprised of (a) a syndiotactic polypropylene copolymer, (b) 5 to 70 parts of a rubbery elastomer that is comprised of repeat units that are derived from a conjugated diene monomer selected from 1,3-butadiene and isoprene, wherein the rubbery elastomer is at least partially crosslinked, wherein the repeat units in the rubbery polymer are distributed throughout the rubbery polymer in an essentially random manner, and wherein the rubbery polymer is a solution polymer, (c) 5 to 90 parts of a highly saturated elastomer selected from the group consisting of styrene-ethylene butylene-styrene polymers (SEBS), styrene-ethylene propylene-styrene polymers (SEPS), hydrogenated polybutadiene, hydrogenated polyisoprene, hydrogenated styrene-isoprene random copolymers, hydrogenated styrene-butadiene random copolymers, and (d) a crosslinking agent.

29. An article of manufacture as specified in claim 1 wherein the hard substrate is a thermoplastic resin.

30. An article of manufacture as specified in claim 1 wherein the hard substrate is a metal.

5 31. An article of manufacture as specified in claim 1 wherein the thermoplastic resin is polystyrene.

32. A process as specified in claim 17 wherein the thermoplastic resin is polystyrene.

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33. An article of manufacture as specified in claim 3 wherein the thermoplastic resin is an isotactic polypropylene copolymer with an alpha-olefin monomer selected from the group consisting of ethylene, butene and hexene which is prepared with non-metallocene catalyst.

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34. A polymeric composition which is comprised of (a) an isotactic polyolefin copolymer resin of polypropylene and an alpha-olefin monomer selected from the group consisting of ethylene, butene, hexene, and octene, wherein the said copolymer is prepared with Ziegler-Natta catalyst (b) 5 to 70 parts of a rubbery elastomer that is comprised of repeat units that are derived from a conjugated diene monomer selected from the group consisting of 1,3-butadiene and isoprene, wherein the rubbery elastomer is at least partially crosslinked, wherein the repeat units in the rubbery polymer are distributed throughout the rubbery polymer in an essentially random manner, and wherein the rubbery polymer is a solution polymer, (c) 5 to 90 parts of a highly saturated elastomer selected from the group consisting of styrene-ethylene butylene-styrene polymers, styrene-ethylene propylene-styrene polymers, hydrogenated polybutadiene, hydrogenated polyisoprene, hydrogenated styrene-isoprene random copolymers, and hydrogenated styrene-butadiene random copolymers, and (d) a crosslinking agent.

20 25 30 35. An article of manufacture as specified in claim 1 wherein the soft thermoplastic composition is further comprised of a rubbery polymer selected from the group consisting of ethylene-propylene-diene rubber, butyl rubber, halobutyl rubber, ethylene-co-octene elastomer, ethylene-co-hexene elastomer, ethylene-co-butene

elastomer, halogenated rubber copolymers of p-alkylstyrene and at least one isomonoolefin having from 4 to 7 carbon atoms, and nitrile rubber.

36      A thermoplastic elastomer composition which is comprised of (a) 5 to 60  
5      parts by weight of a thermoplastic resin selected from the group consisting of polyolefin  
resin and polystyrene, (b) 5 to 70 parts by weight of a rubbery elastomer that is  
comprised of repeat units that are derived from a conjugated diene monomer selected  
from 1,3-butadiene and isoprene, wherein the repeat units in the rubbery polymer are  
distributed through the rubbery polymer in an essentially random manner, wherein the  
10      rubbery polymer is a solution polymer, and is optionally, at least partially crosslinked,  
(c) 5 to 90 parts by weight of a highly saturated elastomer selected from the group  
consisting of styrene-ethylene butylene-styrene, styrene-ethylene propylene-styrene,  
hydrogenated polybutadiene, hydrogenated polyisoprene, hydrogenated styrene-isoprene  
random copolymers, hydrogenated styrene-butadiene random copolymers, hydrogenated  
15      styrene-isoprene block copolymers, and hydrogenated styrene-isoprene/butadiene-  
styrene block copolymer, and (d) 15 to 200 parts by weight of an oil.

37.      A thermoplastic elastomer composition as specified in claim 36 wherein  
the thermoplastic resin is a continuous matrix phase, wherein the rubbery elastomer is a  
20      dispersed phase, and wherein the highly saturated elastomer is a dispersed phase.

38.      A thermoplastic elastomer composition as specified in claim 36 wherein  
the thermoplastic resin is a co-continuous phase, wherein the rubbery elastomer is a co-  
continuous phase, and wherein the highly saturated elastomer is a co-continuous phase.  
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39.      A thermoplastic elastomer composition as specified in claim 36 wherein  
the highly saturated elastomer is a continuous matrix phase, wherein the rubbery  
elastomer is a dispersed phase, and wherein the thermoplastic resin is a dispersed phase.

40.      A thermoplastic elastomer as specified in claim 36 wherein the rubbery  
30      elastomer is styrene-butadiene rubber.

41.      A thermoplastic elastomer as specified in claim 40 wherein the styrene-

butadiene rubber has a bound styrene content of 10 to 40 weight percent.

42. A thermoplastic elastomer as specified in claim 41 wherein the styrene-butadiene rubber has a vinyl content which is within the range of 10 to 60 percent.